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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JOHN DAVIS HOLDER

Appeal 2008-1072
Application 10/002,862
Technology Center 1700

Decided: March 6, 2008

Before EDWARD C. KIMLIN, THOMAS A. WALTZ, and
PETER F. KRATZ, *Administrative Patent Judges*.

KRATZ, *Administrative Patent Judge*.

DECISION ON APPEAL

1 This is a decision on an appeal from the Examiner's final rejection of claims 1-107, the only claims that remain pending in this application. We have jurisdiction pursuant to 35 U.S.C. § 6.

Appellant's disclosed invention is primarily directed to a silicon melt preparation process using a rotating crucible from which a single crystal silicon ingot is grown via the Czochralski (CZ) method (Specification 1 and 4). The argued improvement essentially relates to the addition of non-melted polycrystalline silicon via intermittent delivery into the crucible and onto an exposed portion of non-melted polysilicon of a partially melted charge therein. Claim 1 is illustrative and reproduced below:

1. A process for preparing a silicon melt in a crucible from which a single crystal silicon ingot is grown for use in growing the single crystal silicon ingot by the Czochralski method, the process comprising:

a. forming a partially melted charge in the crucible, the partially melted charge comprising molten silicon and unmelted polycrystalline silicon, the molten silicon having an upper surface, the unmelted polycrystalline silicon comprising an exposed portion that is above the upper surface of the molten silicon;

b. rotating the crucible from which the single crystal silicon ingot is grown;

c. feeding additional unmelted polycrystalline silicon into the rotating crucible by intermittently delivering the additional unmelted polycrystalline silicon out of a feed tube in the crucible and onto the exposed portion of the unmelted polycrystalline silicon of said partially melted charge in the crucible from which the single crystal silicon ingot is grown, the intermittent delivery comprising a plurality of alternating on-periods and off-periods, wherein each on-period comprises flowing the additional unmelted polycrystalline silicon through a feed device that directs the flow of the additional unmelted polycrystalline silicon onto the unmelted polycrystalline silicon of the partially melted charge in the crucible for an on-duration, and each off-period comprises interrupting the flow of the additional unmelted polycrystalline silicon for an off-duration; and

d. melting the unmelted polycrystalline silicon and the additional unmelted polycrystalline silicon to form the silicon melt in the crucible from which the single crystal silicon ingot is grown.

The Examiner relies on the following prior art references as evidence in rejecting the appealed claims:

Kamio	U.S. 5,087,429	Feb. 11, 1992
Holder	U.S. 5,588,993	Dec. 31, 1996

Claims 1-107 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Holder in view of Kamio.

We agree with the Examiner's obviousness conclusion as set forth in the Answer. Our reasoning follows.

With regard to obviousness, in *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007), the Supreme Court stated that "Section 103 forbids issuance of a patent when 'the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.'"

Appellant presents five claim groupings with the claims of each grouping argued together (Br. 12).

Group I.

Starting with the first claim grouping (claims 1-18, 32-35, 59, 68-76, 85, and 97-102), we select claim 1 as the representative claim on which we decide this appeal as to the Examiner's rejection of the commonly rejected and argued claims of the first claim grouping.

Like Appellant, Holder discloses a CZ process for producing single crystal silicon and employs a CZ crucible for melting polycrystalline silicon.

Appellant does not dispute that Holder discloses a process for preparing a silicon melt employing a CZ crucible substantially corresponding to the process of representative claim 1 but for the argued claim requirement for “intermittently delivering the additional unmelted polycrystalline silicon ... onto the exposed portion of the unmelted polycrystalline silicon of said partially melted charge...” as recited in representative claim 1. Thus, Appellant has basically conceded that the applied prior art, including Holder, teaches or would have suggested to one of ordinary skill in the art that the CZ crucible is or can be rotated during the melting process disclosed therein, as is called for in the rejected claims. Arguments not made in the Briefs are considered to be waived. *See* 37 C.F.R. § 41.37(c)(vii)(2006).

While Holder does not explicitly specify using intermittent delivery as an option, Holder does controllably deliver additional unmelted polycrystalline silicon (granular silicon) onto an exposed portion of non-melted polycrystalline silicon previously charged to the melting crucible (Abstract, col. 4, l. 66-col. 6, l. 55, l. 65). Also, while Holder may disclose a continuous feeding embodiment, Holder does not specify that continuous granular silicon feed is necessary to affect the requisite control in feeding the granular silicon. In this regard, Holder is concerned with feeding the granular polycrystalline silicon onto an exposed portion of an island of previously charged non-molten polycrystalline silicon present in a melting crucible in a controlled manner that allows the granular feed sufficient time to dehydrogenate while replenishing the island therewith before it becomes immersed in the molten silicon inside the crucible. (*Id.*).

Concerning the intermittent feed limitation of the claimed method, we agree with the Examiner’s conclusion that it would have been obvious to one

of ordinary skill in the art to feed granular silicon in a discontinuous or intermittent fashion for deposit on the non-melted charge of the melting crucible of Holder as an alternative to supplying such material in a continuous fashion based on the totality of the evidence of record. In this regard, we observe that Appellant has acknowledged that a prior art device for the metered or controlled delivery of solids, such as silicon in such an intermittent fashion is known (Specification, p. 14, l. 28 – p. 15, l. 5).¹ Given the teachings of Holder and this acknowledged prior art, the record furnishes ample evidence to support the Examiner's obviousness determination as to the alternative of intermittently feeding the added granular silicon of Holder. As pointed out by the Examiner, there are only two options in that Holder's added granular silicon must be delivered in either a continuous or discontinuous (intermittent) fashion (Ans. 3). Selecting the latter option would have been well within the ordinary skill of the artisan based on this record. After all, in an obviousness assessment, skill is presumed on the part of the artisan, rather than the lack thereof. *In re Sovish*, 769 F.2d 738, 742 (Fed. Cir. 1985).²

Against his backdrop, Appellant's assertion of a lack of suggestion or motivation for the proposed modification of Holder based on a narrow reading of the teachings of the applied references, as well as the claimed

¹ The starting point for Appellant's invention, for purposes of 35 U.S.C. § 103(a), is what Appellants acknowledge to be prior art. *In re Facius*, 408 F.2d 1396, 1406 (CCPA 1969); *In re Davis*, 305 F.2d 501, 503 (CCPA 1962).

² In light of these determinations, a further discussion of the additional teachings of Kamio respecting the intermittent feeding of silicon to a molten silicon feeding section of a crucible in the formation of silicon single crystals, as further relied upon by the Examiner in the Answer, is not necessary herein.

subject matter, is not persuasive of reversible error in the stated rejection. Representative claim 1 does not require any particular intermittent granular silicon feed cycle, only that the delivery be turned on and off at least twice during the melting and with no limitation as to the length of time spent in the on or off periods.

Moreover, it has not been fairly established that Holder teaches away from or against employing intermittent granular silicon delivery based on the allegedly slow feed rate of Holder and the asserted counter-intuitiveness of using an intermittent feed. In this regard, we note that the asserted reduction in feed time associated with using intermittent delivery is not persuasive in that representative claim 1 is not limited to a process conducted in accordance with the Specification Examples 1 and 2 (Br. 17). Thus, Appellant's arguments are not commensurate in scope with the representative claim 1 process.

Indeed, we note that Appellant's remarks with regard to the alleged superiority of intermittent feeding as to shortening the melting time are undercut by a subject Specification passage suggesting a decrease in time only preferably occurs for Appellant's process and then only under certain manners of intermittent operation (Specification, p. 10, ll. 15-20). Here, representative claim 1 is not even limited to a method with a specific intermittent granular silicon delivery technique, much less a feeding technique that significantly reduces melting time in an unexpected manner. As for Appellant's remarks regarding the lack of support for an equivalency between intermittent and continuous granular silicon delivery (Br. 17-20), such argument is not persuasive because the Examiner's obviousness

assessment is not limited to a rationale based on strict identity of outcome for continuous or intermittent feeding operations (Ans. 7- 9).³

After all, “analysis [of whether the subject matter of a claim is obvious] need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *KSR*, 127 S. Ct. at 1741. In this regard, the disclosure of each applied reference is considered for what it fairly teaches or suggests to one of ordinary skill in the art, including not only the specific teachings, but also the inferences which one of ordinary skill in the art would reasonably have been expected to draw therefrom. *See In re Boe*, 355 F.2d 961, 965 (CCPA 1966); and *In re Preda*, 401 F.2d 825, 826 (CCPA 1968). In the case before us, we are satisfied that conducting the granular silicon delivery of Holder in a discontinuous fashion would have been an obvious option well within the grasp of one of ordinary skill in the art based on the prior art teachings and acknowledgments before us in this record notwithstanding the contrary contentions set forth in the Briefs.

It follows that we shall affirm the Examiner’s obviousness rejection of representative claim 1 and the claims grouped together therewith.

Group II.

Concerning Appellant’s second claim grouping (claims 19-31, 61, and 77-84), which have been argued together in the Briefs, we select claim 19 as the representative claim on which we decide this appeal as to these claims.

³ The Examiner’s references to Hansen in the Answer are readily understood as being references to Holder.

Representative claim 19 requires, *inter alia*, that the granular silicon feed rate is at least 1 gram per second (at least 3.6 kilograms per hour) during the silicon delivery “on” time of the intermittent feeding.

Appellant contends that arriving at such a flow rate for the intermittent “on” time for silicon delivery would not have been a matter of routine optimization for one of ordinary skill in the art based on the applied prior art because such a variable has not been recognized by the applied art as being result effective. We are not persuaded by this argument because Holder discloses a gross feed rate for the polysilicon of from about 5-15 kg/hr to minimize thermal stresses on the crucible (Holder, col. 6, ll. 3-11). As such, it is our view that one of ordinary skill in the art would have been reasonably led to employ similar, if not greater, silicon feed rates during intermittent silicon feeding time periods in choosing an intermittent supplying option for the granular silicon feed of Holder.

It follows that, on this record, we shall affirm the Examiner’s obviousness rejection of representative claim 19 and the claims that stand or fall together therewith in Appellant’s second claim grouping.

Group III.

Appellant’s third claim grouping includes claims 36-51 and 86-89. As these claims have been argued together in the Briefs, we select claim 36 as the representative claim on which we decide this appeal as to this claim grouping.

Claim 36 additionally requires that a radial outwardly-extending wedge-shaped portion of exposed unmelted polycrystalline silicon is a portion thereof upon which granular polysilicon is delivered intermittently.

The Examiner basically maintains that Holder discloses or suggests rotating the melting crucible during the granular silicon delivery onto non-molten polycrystalline silicon as illustrated in Figure 3, which disclosure would suggest that the granular silicon feed of Holder, when modified to be supplied intermittently as found to be obvious herein, would also reasonably be expected to accumulate on wedge-shaped portions of the non-melted silicon in the crucible (Ans. 10).

While the Examiner employs the term “inherent” at page 6 of the Answer, it is reasonably clear that the Examiner’s obviousness position is not limited to such a theory. Rather, the obviousness assertions embrace the notion that upon modification of Holder’s method to include intermittent input of the added granular silicon feed, the intermittently deposited feed would reasonably be expected to be delivered to a wedge-shape area of the non-melted island of previously charged polycrystalline silicon as illustrated in drawing Figure 3 of Holder. We agree with that obviousness assessment of the Examiner. In this regard, it is instructive to note that representative claim 36 does not require any particular type shape of the wedge portion of the unmelted previously charged polysilicon. Nor has Appellant established any criticality for a wedge shape, in general. In other words, only predictable expected results are obtained by the claimed process.

On this record, we shall affirm the Examiner’s obviousness rejection of representative claim 36 and the commonly rejected and grouped claims which stand or fall together therewith.

Group IV.

Appellant’s fourth claim grouping includes claims 52-58, 60, 62-67, and 90-96. As these claims have been argued together in the Briefs, we

select claim 52 as the representative claim on which we decide this appeal as to this claim grouping.

Representative claim 52 requires, *inter alia*, that a wedge shape portion of non-melted polycrystalline silicon in a melting crucible does not overlap any preceding wedge portion of the non-melted polycrystalline silicon in the melting crucible.

The Examiner basically maintains that Holder discloses or suggests rotating the melting crucible during the granular silicon delivery onto non-molten polycrystalline silicon as illustrated in Figure 3. In this regard, Holder teaches that “[t]he granular-polycrystalline silicon **40** forms an island **44** ... with the slope of the island **44** equal to the angel of repose for the granular-polycrystalline silicon **40**” (col. 6, ll. 32-36). This disclosure of Holder would have suggested that the granular silicon feed of Holder, when modified to be supplied intermittently, as found to be obvious herein, would also reasonably be expected to accumulate so as to form some type of wedge-shaped portions of non-melted silicon in the crucible of Holder (Ans. 10-11).

We rely on our determinations above for our reasoning concerning why arguments made for either the Group I or Group III claims are not persuasive with respect to the Group IV claims, particularly representative claim 52.

Also, Appellant’s additional argument that the applied prior art furnishes “no motivation toward the wedge positions as defined by the Group IV claims” (Br. 30) is not persuasive of the unobviousness of the representative claim 52 method primarily because representative claim 52 does not require specific wedge positions to be formed during the claimed

method. Thus, this additional contention does not fairly explain how the Examiner's position as to the obviousness of employing intermittent granular silicon feed in Holder is deemed unsound by Appellant.

It follows that we shall affirm the Examiner's obviousness rejection of representative claim 52 and the commonly rejected and grouped claims which stand or fall together therewith.

Group V.

Appellant's fifth claim grouping includes claims 103-107. As these claims have been argued together in the Briefs, we select claim 103 as the representative claim on which we decide this appeal as to this claim grouping.

Representative claim 103 depends from claim 1 and requires that an ingot is pulled from the molten polycrystalline silicon leaving a depleted silicon charge. Holder discloses that the polycrystalline processing therein is optimized with regard to single crystal silicon ingot quality and production throughput (col. 4, ll. 3-6). Thus, Appellant's additional argument respecting Kamio is unpersuasive in that Kamio is not necessary to support the Examiner's position with respect to the obviousness of dependent claim 103 for substantially the reasons we set forth above in considering the Examiner's rejection of claim 1.

It follows that we shall affirm the Examiner's rejection of representative claim 103 and claims 104-107, which latter claims stand or fall together with claim 103.

CONCLUSION

The decision of the Examiner to reject claims 1-107 under 35 U.S.C. § 103(a) as being unpatentable over Holder in view of Kamio is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv)(2006).

AFFIRMED

PL Initial:
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